FINAL
TECHNICAL MEMORANDUM NO. 7

ADDENDUM TO FINAL PHASE I RFI/RI WORK PLAN

Soil Boring Sampling Plan -- Ash Pits 1-4, Incinerator and Concrete Wash Pad

Rocky Flats Plant
Woman Creek Priority Drainage

(Operable Unit No. 5)

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Prepared for:

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Approved By:

Name (Date)

1.0 INTRODUCTION

1.1 BACKGROUND

Soil borings are proposed as part of the Phase I RCRA Facility Investigation/Remedial Investigation (RFI/RI) of Operable Unit No. 5 (OU5) in the areas of the Ash Pits (IHSSs 133.1-133.4), Incinerator (IHSS 133.5) and Wash Pad (IHSS 133.6) (Figure 1) to characterize cover and subsurface materials, to help delineate the boundaries of the Ash Pits, Incinerator and Wash Pad, and to characterize subsurface contamination.

The Incinerator, Ash Pits, and Concrete Wash Pad are located south-southwest of the main security area of the Rocky Flats Plant within the Woman Creek drainage (Figure 2). The Incinerator, which had a 10- to 20-foot stack, was located along the plant's original west boundary, off of the west access road. The Ash Pits are located to the west of the Incinerator, and the Concrete Wash Pad is located to the southwest of the Incinerator (Figure 2).

The area referred to as the "Ash Pits" extends approximately 1,200 feet along an east-west axis and 500 feet along a north-south axis. Within this area are four separate previously identified ash pits (IHSSs 133.1, 133.2, 133.3, and 133.4), and four other possible ash pits, covered trenches, or disturbed areas that have been identified through aerial photograph review and geophysical surveys (see Sections 2.1 and 2.2). Based on the review of aerial photographs and the geophysical survey conducted as part of the OU5 RFI/RI, the boundaries to the Ash Pits, the Incinerator, the Concrete Wash Pad, and other areas that appear to have been disturbed during some time in the past are shown on Figure 2. The four Ash Pits and four other disturbed areas are located on a relatively flat to steep surface and are currently covered by tall grasses.

The Incinerator area occupies approximately 17,500 square feet and the Concrete Wash Pad area occupies approximately 37,500 square feet. The Concrete Wash Pad has an extremely irregular hummocky surface that slopes to the south toward Woman Creek. The Incinerator area is relatively flat with a slight slope to the south.

The Incinerator was used to burn general plant wastes, such as general combustible and noncombustible wastes, between the 1950s and 1968 (Rockwell, 1988). An estimated 100 grams of depleted uranium is also believed to have been burned in the incinerator (Owen and Steward, 1973). A review of aerial photographs revealed that the Incinerator was removed by 1971 and the entire area had begun to revegetate (U.S. EPA 1988). Ashes from the Incinerator were placed into the Ash Pits or were pushed over the side of the hill into the Woman Creek drainage and/or onto the Concrete Wash Pad (Rockwell, 1988).

According to the OU5 Work Plan, a rayscope survey was conducted over Ash Pit 3 (IHSS 133.3) prior to 1973 and the results of this survey detected metals of an unknown type (U.S. DOE, 1992a).

The history of the Concrete Wash Pad has not been as well documented as the Ash Pits or Incinerator area. However, it appears that this area was used to dispose of waste concrete from trucks involved in the construction of the plant facilities. It is also likely that the concrete trucks were washed down in this area after delivering concrete. Potentially contaminated materials consisting of concrete debris and some ashes from the Incinerator were reported to have been pushed over the side of the hill onto the Concrete Wash Pad (U.S. DOE, 1992b).

1.2 PURPOSE AND SCOPE

This TM is intended to provide a revised soil boring program for the Ash Pits, Incinerator, Concrete Wash Pad, and recently identified disturbed areas (i.e. covered ash pits or trenches).

Soil borings will be drilled to characterize, geologically and chemically, the cover and subsurface materials within and/or downgradient the Ash Pits, Incinerator, and Concrete Wash Pad areas and to characterize the contamination sources at IHSS 133. The soil borings will also assist in assessing the lateral and vertical extent of the ashpits. Additionally, the soil borings are intended to provide information as to whether contaminants exist within the Ash Pits, and if so what contaminants are present, and have these contaminants leached into the soils and/or groundwater beneath or downgradient of the Ash Pits.

Further, these borings are intended to determine if groundwater is present and at what depth (eg., is the groundwater flowing through the ash materials within the Ash Pits). If it is determined that groundwater is present, one-time groundwater samples will be collected from the soil borings. The data collected from the groundwater samples will be used to assess if contaminants have reached the water table from the Ash Pits, Incinerator, and/or Concrete Wash Pad areas.

The RFI/RI Work Plan for OU5 proposed borings to be placed on 25-foot centers that transect each IHSS in order to delineate the boundaries of the Ash Pits. The Work Plan also stipulates that if the boundaries of IHSS 133 can be determined by aerial photography review, radiological survey and/or the proposed geophysical surveys, fewer soil borings will be necessary. The aerial photograph review and geophysical survey results have been partially successful at delineating these boundaries and are presented in this TM.

This memorandum incorporates the currently available information from an aerial photograph review, information from the geophysical survey, the Inter-Agency Agreement (IAG), the February 1992 Phase I RFI/RI Work Plan for OU5, and EG&G Standard Operating Procedures (SOPs).

2.0 PRELIMINARY FIELD WORK

Existing aerial photographs were reviewed and a geophysical survey was conducted as part of Stages 1 and 2 of the RFI/RI for IHSSs 133.1 - 133.6. The photographs were examined to assess the extent of the Ash Pits, Incinerator and Concrete Wash Pad. The results of this review are presented below. The geophysical survey of IHSSs 133.1 - 133.6 was conducted during the first quarter of FY 1993 and consisted of magnetometer and electromagnetic surveys.

The magnetometer survey was used to locate subsurface ferrous objects. Such objects may be an indication of buried waste, thereby indicating possible IHSS boundaries. Results from the electromagnetic (EM) survey have indicated the presence of conductive materials, also indicating possible buried waste. In addition, the EM survey can detect differences in the conductivity of geologic materials which would assist in delineating the size of trenches, the results are presented below. The final specifications of soil boring locations have been based on the delineation of the IHSS boundaries from the results of these surveys.

2.1 AERIAL PHOTOGRAPH REVIEW

A review of aerial photographs covering the IHSS 133 has been completed. The object of this review was to substantiate the locations of the IHSSs as presented on Figure 7-3 of the OU5 Phase I RFI/RI Work Plan, to determine if additional suspect sites exist that should be included in future site investigations, and to determine the method in which the ashes were laid into the Ash Pits.

The aerial photographs used for this review were those contained in the AERIAL PHOTOGRAPHIC ANALYSIS COMPARISON REPORT, prepared by the U.S. Environmental Protection Agency (U.S.EPA) Environmental Monitoring Systems Laboratory in 1988 (U.S.EPA, 1988) as well as additional photographs obtained from RFP photography. These photographs were taken in the years 1953, 1955, 1964, 1971, 1978, 1980, 1983, 1986, and 1988. This review was conducted using both vertical and oblique aerial photographs of the area and resulted in revisions to the locations of IHSSs 133.2, 133.3 and 133.4. Other suspect sites were identified during the review. A subsequent field investigation determined that some of the suspect sites were dumped concrete.

The locations of IHSSs 133.1 through 133.6 are shown on Figure 2. IHSSs 133.5 (incinerator) and 133.6 (concrete wash pad) are easily identifiable in both the photographs and the field, and essentially agree with the locations shown in the Work Plan. IHSS 133.1 is approximately located as shown in the Work Plan but consists of a concrete dump with no visible indications an ash pit ever existed at this site unless it was covered by the concrete. IHSSs 133.2, 133.3, and 133.4 were easily identified on the oblique photographs and their locations correlate well with sites that were visible on corresponding vertical photographs. These sites are shown on Figure 2 and do not agree with the sites shown on Figure 7-3 of the Work Plan.

Following the aerial photo review, all sites were located on the ground using landmarks that were visible on the oblique photographs. Several of these landmarks (concrete pad, drainage ditch, etc.) are shown on Figure 2 and will be helpful in locating each IHSS during the field investigations.

Additional information that was acquired from the aerial photo review includes the routes that were taken when driving into and out of the Ash Pits. An aerial photo of Ash Pit 133.3 shows a roadway going into and out of the ash pit at the same point. An aerial photo of Ash Pit 133.2 shows a road way circling the ash pit with one side of the circle nearing the edge of the pit. This information indicates that the ashes were simply dumped into the pits either from within the pit (133.3) or from off the edge of the pit (133.2), and that there are no homogenous layers of ash within the Ash Pits. No evidence obtained indicates that the ash was placed in a systematic fashion (i.e., lifts) in the pits.

2.2 GEOPHYSICAL SURVEYS

Electromagnetic (EM) and magnetic field surveys conducted over the IHSS 133 area were completed in mid-December, 1992. Data covering the entire IHSS 133 series area consisting of an EM31 vertical dipole conductivity contour map, an EM31 in phase contour map, a total magnetic field contour map, a magnetic gradient contour map, and a map showing the surface features (concrete dumps, slabs, etc) encountered during the survey traverse (Figures 3 through 7) were used in preparing this TM.

The purpose of the EM31 survey was to determine if the material that was deposited in the ash pits would show a relatively lower conductivity than the surrounding sediments, therefore delineating the pit boundaries. The purpose of the magnetometer survey was to determine if ferromagnetic debris, including drums or parts of the incinerator, had been buried in the pits, which would also be used to delineate the pits and help determine where drill holes should be located.

The data shown on Figures 3, 4, 6, and 7, are essentially from direct field readings except where a minimal magnetic drift correction was applied to the magnetometer data. All data was acquired using a 12.5 foot line spacing and 10 foot station intervals. Only the contour interval was changed, as applicable, to enhance the definition of possible anomalous events.

The effective penetration depth of the EM31 is approximately 15 to 18 feet for the vertical dipole survey, and 5 to 8 feet for the horizontal dipole survey. Very little powerline interference was experienced in the EM survey because the EM31 operates on a frequency of 9.8 KHz, and incorporates 60 cycle filters to minimize the interference from powerlines.

The effective penetration depth of the magnetometer depends on the size and depth of the buried object(s). Because the pits were estimated to be a maximum of 10 to 12 feet in depth, the survey was expected to detect single drums or similar ferromagnetic objects. Because the powerlines produce a strong electromagnetic field (EMF), strong interference was expected in the proximity of the overhead lines.

Conductivity was measured using an EM31 in both a vertical and horizontal dipole mode. The vertical dipole conductivity, which was used exclusively to interpret the conductivity of the area, measures the conductivity of an induced electromagnetic field to determine the conductivity of the earth at a predetermined depth range (depending upon the horizontal spacing of the coils of the instrument being used). A high instrument response indicates the presence of a high conductive material, which can include a highly conductive groundwater, the presence of metallic debris, or a buried strata that is more conductive than the overlying or surrounding sediments.

Both the EM and the magnetometer surveys were partially successful in delineating or confirming the indicated locations of most of the individual IHSS's in the project area. Although the power line which crosses the area from west to east, and a branch line which turns to the north and is located just to the west of the incinerator site, did cause interference with the magnetic survey, as shown on Figures 3 and 4, usable data was acquired over the IHSS's that are located far enough from the power lines to allow magnetic measurements of sufficient intensities to override the EMF interference produced by these lines.

The Surface Features Location Map (Figure 5), which is based on the survey traverse, provides information that has been incorporated into the map shown on Figure 2. Because the traverse was tied to land surveyed base lines, landmarks such as the concrete pad located just to the west of IHSS 133.1 have been more accurately located on Figure 2. Since most of the features shown on the west half of the map were located from this pad and other landmarks that could be easily identified on the vertical aerial photographs, adjustments were subsequently made to some of the IHSSs and other prominent features located on the west side of the map. These changes have resulted in improved correlations of some surface features with anomalies occurring on the EM and magnetic contour maps. It should be noted that a mylar overlay, drafted to the same scale as the geophysical survey maps, was used to identify the anomalies associated with the IHSSs or other features that are identified on the Surface Features Location Map. The results of these surveys are discussed in the following section.

2.2.1 IHSS 133.1

The presence of IHSS 133.1 was not substantiated by either the EM or magnetometer surveys of the area and the inferred ash pit probably does not exist. An on site examination of the area found only small amounts of dumped concrete with little or no indications of any surface disturbance within the area. A small magnetic anomaly was identified that corresponds to an area of dumped concrete on the Surface Features Map. Because drum lids were found in the area, the anomaly is probably attributed to metallic debris in or under the concrete.

2.2.2 IHSS 133.2

IHSS 133.2 has been expanded to include a previously undesignated area to the south of the power lines with approximately the same amount of disturbed surface area as indicated for the original 133.2 pit area (200 ft. x 40 ft.). An examination of a vertical aerial photograph taken on April 10, 1968, indicates that the initial 133.2 pit was approximately 150 feet in length, and was probably half covered at the time the photo was taken. The 1968 photograph further indicates that the pit was filled by direct dumping, and that the material was not evenly distributed throughout the pit. Although both the north and south areas are located within close proximity of the power lines, the total magnetic field map (Figure 3) shows a typical magnetic response to buried magnetic objects indicating the presence of metallic debris in the north pit. Although the magnetic data over the south pit is obscured by the power line interference, it is likely that metallic debris exists in this area. The EM conductivity data shown on Figures 6 and 7 does not delineate the trenches or disturbed ground in either area.

Magnetic objects or debris does not indicate the presence of ash, but does show that ferrometallic objects were buried in the pit. Old photographs of the incinerator that were taken just prior to its removal, showed at least one 55 gallon drum and other metallic debris mixed with the ash in the combustion chamber. This is probably a good indication of the operating practices that existed at that time.

The magnetic low associated with the pit on the north side of IHSS 133.2 is a typical magnetic signature for large buried magnetic objects in the northern hemisphere. This is comparable to the magnetic anomalies found at IHSS 133.3 and IHSS 133.4, where each has a low located to the north of the magnetic high. In the case of 133.2, the magnetic high is obliterated by the highline interference. However, a sensor height test was conducted over 133.2 showed that the response was the same with the detector set at 4 feet, 6 feet, or eight feet. Each detector responded to the negative reading at the same station, and was responding to elevated readings uniformly when entering the area of powerline interference. Under normal conditions (no metallic objects present), the highest detector picked up the powerline interference before the lowest detector and resulted in a staggered response plot.

2.2.3 IHSS 133.3

IHSS 133.3 has been modified to include two trenches within the IHSS boundary. Vertical aerial photographs taken on October 10, 1964, and April 15, 1966, show the open trench on the north with it's approximate center as indicated on Figure 2. A vertical photograph taken on April 10, 1968, indicates the presence of a second filled trench approximately 40 feet to the south of the original trench. The approximate center of this trench is also shown on Figure 2. The vertical photo taken on August 7, 1969, subsequently shows a large reclaimed area that was necessary to accommodate both trenches.

The total magnetic field map (Figure 3) shows well defined magnetic anomalies that correspond to the location of the southern-most pit shown on Figure 2. The configuration and sizes of the anomalies indicates that metallic debris was not uniformly distributed throughout the trench. Data over the indicated north pit was again distorted by power line interference.

The EM survey data, which is shown on Figure 6, defines an area of relative high conductivity which is interpreted to be related to the varying saturation of alluvial sediments, which can vary from clay to gravel within the general area. The conductivity data does not delineate the trenches identified on the aerial photographs because the material filling the trenches, and the sediments surrounding the trenches are probably similar and equally saturated. Although the data failed to delineate the trenches, the overall disturbed area can be readily identified on the ground.

2.2.4 IHSS 133.4

IHSS 133.4, a buried trench, as shown on Figure 2, has been expanded to include a possible disturbed area extending to the northeast from the trench area. The size of each area was determined from vertical aerial photographs and are estimated to be 180 ft. x 40 ft. and 190 ft. x 40 ft., respectively. There are no photographs documenting the presence or sizes of trenches in the area while they were in use.

The EM data was successful in delineating the disturbed areas (Figure 6) and appears to be reliable enough that a slight site location adjustment was incorporated into Figure 2. A well defined elongated magnetic anomaly was recorded over IHSS 133.4 (Figure 3) and indicates the presence of magnetic debris within the east-west pit. The configuration of the anomaly also indicates a moderately uniform distribution of metallic debris through out the trench. No significant anomalies were detected over the northeast area which is subject to EMF interference from the power lines.

2.2.5 IHSS 133.5

IHSS 133.5, which includes the old incinerator site, consists of a broad area covered with gravel and cement rubble piles with scattered metallic debris. Vertical and oblique aerial photographs, which are dated 1966, show the incinerator while it was in operation, and its approximate location has been plotted on Figure 2. Anomalies occurring on the EM survey maps (Figures 6 and 7) coincide with the plotted location of the incinerator and therefore indicate that the foundation and floor were left in place when the incinerator was demolished. The magnetometer data did not fully delineate the site, but contained some weak anomalies that may correspond to the buried foundation.

Topography within the IHSS 133 series area can be interpreted from the EM conductivity map (Figure 6) since the topographic highs are shown as low conductive areas (presumably due to a greater thickness of coarser unsaturated alluvial material) and the drainage ways and topographic lows are shown as higher conductive areas (composed of mixed, possibly more saturated alluvial sediments). The EM vertical dipole conductivity map (Figure 6) clearly defines the topography of the area and the previously existing road that was located below the incinerator. The floor and foundation of the incinerator occur as a rectangular shaped low conductivity anomaly surrounded by a high conductivity halo on both the EM conductivity and in phase maps (Figures 6 and 7).

The magnetic data varies from good to questionable because of the north-south power lines that cross the site on the west side. The best interpretation that could be made from this data is that some anomalies occurring in the vicinity of the incinerator site, which are assumed to be far enough away from the power lines to override any EMF interference, may be attributed to shallow or surface metallic debris.

2.2.6 IHSS 133.6

IHSS 133.6 encompasses the concrete wash pad area which was active during the 1950's. The general configuration of the site was derived from vertical aerial photographs and is shown on Figure 2. The overall site is fairly large, and the concrete appears to be the thickest along the north side where the trucks were probably dumped and washed out.

The site is partially delineated by the EM survey. The vertical dipole conductivity map (Figure 6) shows an area of low conductivity that probably coincides with the area of thick concrete cover. The map then grades into a larger area showing a higher conductivity that is most likely indicative of more conductive or partially saturated alluvial sediments that underlie the dump area.

A strong magnetic anomaly occurs along the north side of the area that generally appears to be outside of the interference from the power lines (Figure 3). Continuing to the south, this anomaly grades into a band showing lower magnetic intensities. The perimeter of the site was then mapped at background levels with no significant anomalies. Based upon the above configuration, it can be assumed that some magnetic metallic debris was buried or dumped along the north half of the site.

2.3 HPGe SURVEY

The radiation survey of the IHSS 133 area was initiated in the summer of 1992 using tripod-mounted, single crystal, high purity germanium (HPGe) gamma-ray detector instruments. A 150 foot grid pattern was used for the survey. This initial survey, now complete, will be followed by a second HPGe survey utilizing the six detector instruments arranged to count activity over a larger area. In addition, a FIDLER survey will be conducted at anomalous areas identified by the two HPGe surveys.

The initial survey was conducted using tripod mounted HPGe instruments operating at a height of 1 meter. At this height, it is assumed that 90 percent of the detectable gamma-ray emissions originate within a counting area (field of view) having a radius of approximately five meters. The remaining 10 percent of gamma radiation detected by the HPGe (or any crystal based detector, for example sodium iodide FIDLER instruments) is assumed to originate outside the five meter counting area. The 150 foot grid spacing coupled with the five meter counting area give

HPGe coverage of approximately five percent of the total surface area of the IHSS 133 area. The second HPGe survey of the IHSS area will result in full coverage of the identified IHSS.

The HPGe system is used to estimate in-situ concentrations of radioactive elements and/or their associated daughter products. The naturally occurring elements included in the HPGe survey are uranium and thorium, and their decay products, and radioactive potassium. Because some of the elements are either weak or non-gamma emitting, their in-situ concentrations must be extrapolated from their respective daughter (decay) products. The accuracy of the inferred concentrations are therefore dependent upon the equilibrium state of each of the elements at each survey station. In this survey the concentrations of radium 226 (Ra_{226}), thorium 232 (Th_{232}), and uranium 238 (U_{238}) are extrapolated (inferred) values which are expressed in picocuries per gram (pCi/g). Cesium 137 (Cs_{137}), americium 241 (Am_{241}), and plutonium 239 (Pu_{239}) were also included in the survey, with Cs_{137} being the only isotope present in measurable quantities.

The results of this survey will be reported after the second survey has been completed.

2.4 ADDITIONAL INVESTIGATIONS

Interviews were conducted in an attempt to acquire information about the operational history of the Ash Pits. Employees who worked at the Ash Pits during the early 1960's, indicated that the ashes were collected at the Incinerator in a dumpster. The dumpster was then transported to the Ash Pits and dumped. There was no spreading of the ashes, therefore there are not homogenous layers of ash in the Ash Pits.

3.0 SOIL BORING PROGRAM

3.1 SOIL BORING LOCATIONS

As specified in Section 1.2 Purpose and Scope, the purpose of the soil borings is to characterize, geologically and chemically, the cover and subsurface materials within and/or downgradient of the Ash Pits, Incinerator, and Concrete Wash Pad areas and to characterize the contamination sources at IHSS 133. The soil borings will also assist in assessing the lateral and vertical extent of the ashpits.

Currently, the soil boring program is expected to encompass the areas occupied by the Ash Pits, Incinerator, Concrete Wash Pad, disturbed areas and a section of the hillside south of IHSS 133.6 and north of Woman Creek (as determined by the aerial photographs and the 1992 HPGe gamma radiation survey). The soil boring program includes a total of 28 borings. Eighteen borings will be placed on 50- to 100-foot centers along the long axes of IHSSs 133.2 through 133.4 and associated covered trenches or pits (Figure 8). Two borings will be placed in IHSS 133.5 in the approximate area of the incinerator pad. One boring will be placed in IHSS 133.1 to confirm the validity of the geophysical survey (is an Ash Pit present or not at this location). Three borings will be placed downgradient of IHSS 133.6 on 100-foot centers. Borings will not be placed within IHSS 133.6 since this IHSS is a steep slope consisting of presumably thick concrete. Additional areas to be investigated are discussed in the following paragraph.

The Historical Release Report (HRR) (U.S. DOE, 1992b) suggests that the areas southeast and southwest of the incinerator may have been used for disposal of ashes; therefore one boring is proposed for each of these areas (Figure 8). The OU5 RFI/RI Work Plan states that ashes may have been pushed over the hillside into the Woman Creek drainage, but it is not specific as to the location of this activity. Since Woman Creek runs fairly close to IHSS 133.6, and this area is just south of the Incinerator, the three borings on 100-foot centers proposed to investigate IHSS 133.6 will also serve to investigate the area, described in the Work Plan, between these IHSSs and Woman Creek (Figure 8). An additional disturbed area was identified in the aerial photograph review (Figure 2). Two borings are proposed for investigation of the "pit and disturbed area" east of the Ash Pits.

As specified in the OU5 Work Plan, soil borings will also be placed in the central location of any anomalous areas detected by the HPGe survey. As stated in Section 2.3, the HPGe survey of the IHSS 133 series has not been fully evaluated, additional borings may be proposed to investigate any anomalies detected.

A brief site visit indicated the terrain to be rough and steep in places. Such features may make access to soil boring sites difficult. Therefore, the proposed soil boring locations may be adjusted to accommodate for field conditions.

The borings that are to be installed for the investigation of IHSSs 133.1 - 133.6 will be drilled 6 feet into weathered bedrock. If the bedrock encountered during drilling is a sandstone, the borings will be advanced 6 feet into the next claystone horizon. Since sandstone units are potential pathways for contaminant transport, it is important to assess the extent and thickness of these units. The thickness of the colluvium and Rocky Flats Alluvium (geologic formations that overlie the bedrock) in this area is unknown since the three closest monitoring wells (1474, 5686, and B402689) have been drilled within the Woman Creek drainage itself and thus encountered somewhat different geologic conditions (U.S. DOE, 1992a). The colluvium and Rocky Flats Alluvium have been estimated to be approximately 20 feet thick based on the isopach map of the colluvium and alluvium provided in the Work Plan for the Original Landfill (IHSS 115). IHSS 115 lies approximately 500 feet to the east of the Ash Pits and is on a similar slope and aspect. Based on the above information, it is estimated that the total depth of these borings will be approximately 25 feet.

Figure 8 shows the proposed soil boring locations. The drilling and soil sampling techniques that will be implemented during this drilling program are described in detail in the following sections.

3.2 DRILLING PROCEDURES

Hollow-stem augers will be used for advancing boreholes. With this technique, samples will be obtained either with standard split spoon or California drive samplers, or with a continuous core augering technique. The continuous coring technique can obtain up to 5-foot-long cores in a 5-foot-long sample barrel provided the geologic material is fairly cohesive. Drive sampling will obtain an 18- to 24-inch-long sample depending on the length of the sampler. Visual logging of the alluvial and bedrock materials will be performed according to SOP GT.1, Logging Alluvial and Bedrock Material (EG&G, 1992a). All sampling equipment will be protected from the ground surface with clear plastic sheeting. Drilling and sampling equipment and materials that will be available will be as specified in SOP GT.2, Drilling and Sampling Using Hollow-Stem Auger Techniques (EG&G, 1992b). Drilling and sampling activities will be conducted in accordance with the Site-Specific Health and Safety Plan.

All drilling equipment, including the rig, water tanks, augers, drill rods, samplers, etc., will be decontaminated before arrival at the work site (i.e. any area to be investigated within OU5). Between boreholes, all down-hole equipment will be decontaminated, and sampling equipment will be decontaminated between samples. The drill rig will be decontaminated between each IHSS. Equipment will be inspected for evidence of fuel oil or hydraulic system leaks (See SOP FO.3, General Equipment Decontamination (EG&G, 1992c), and SOP FO.4, Heavy Equipment Decontamination (EG&G, 1992d)). If lubricants are required for down-hole equipment, only pure vegetable oil will be used.

Before drilling, boring locations will have been numbered and identified using stakes. Utility clearance will have been accomplished according to SOP GT.10, Borehole Clearing (EG&G, 1992e). The results of the geophysical survey will also be reviewed in an attempt to locate possible buried metal objects at each boring location.

After borehole locations have been cleared and obstructions removed, an exclusion zone will be established according to the Site-Specific Health and Safety Plan, and the drill rig will be set up. The boring will be advanced to the depth indicated and sampled according to section 3.3.

The borings will be logged lithologically by examination and geologic classification of the samples. Documentation will be completed by the site geologist according to Section 8.0 of SOP GT.2, Drilling and Sampling Using Hollow-Stem Auger Techniques (EG&G, 1992b). SOP GT.1, Logging Alluvial and Bedrock Material (EG&G, 1992a), describes procedures for material classification and borehole logging.

During the drilling and while the augers are being removed, the cuttings and unsaved portions of samples from the boring will be containerized according to SOP FO.8, Handling of Drilling Fluids and Cuttings (EG&G, 1992h), and SOP FO.9, Handling of Residual Samples (EG&G, 1992i).

3.2.1 Boring Completion And Abandonment

After the borehole has been advanced to its final depth, it will be abandoned according to SOP GT.5, Plugging and Abandonment of Boreholes (EG&G, 1992j).

The boring location stake will be left in the ground adjacent to the borehole, and a board or other cover placed over the hole until it has been grouted. All boreholes to be abandoned with a depth greater than one foot will be grouted the same day that abandonment is completed. The boring location stake will then be placed in the grout. If any borings are less than one-foot deep, they will be abandoned by simply backfilling the hole with the native soil.

3.2.2 Decontamination

Generalized equipment decontamination procedures will include decontamination of sampling equipment and decontamination of drilling equipment.

Decontamination of sampling equipment will be conducted between individual sampling points to minimize potential cross-contamination. Sampling equipment will be decontaminated according to SOP FO.3, General Equipment Decontamination (EG&G, 1992c). During drilling and sampling, decontaminated equipment will be placed on new plastic or racks until used. At least two sets of samplers will be available so that one set can be used while the other is being decontaminated.

Decontamination of augers, drill stems, drill bits, and other down-hole equipment will be conducted after each boring is complete. Drill rigs will be decontaminated when moved out of an IHSS or when they become unusually dirty as a result of site or drilling conditions, at the discretion of the site or project manager. Decontamination of drilling equipment is described in more detail in SOP FO.4, Heavy Equipment Decontamination (EG&G, 1992d).

3.2.3 Documentation

All information required by SOP GT.2, Drilling and Sampling Using Hollow-Stem Auger Techniques (EG&G, 1992b), will be documented on the Borehole Log Form, Form GT.1A (Figures 9-A and 9-B), and the Hollow-Stem Auger Drilling Field Activities Report Form, Form GT.2A (Figure 10). The Field Activities Report Form will be filled out for each day of drilling at a given borehole location and, in situations where more than one boring is drilled and completed per day per drill rig, at least one form will be completed per boring. The borehole log will include information on subsurface material classification and lithology. The Field Activities Report will include the following information and have space for comments and documentation of general observations:

- Project, crew, drilling contractor and borehole identifications
- Date
- Weather
- Site visitors
- Equipment descriptions (rig, bits, etc.)
- Water level
- Depth to bedrock
- Borehole depth and diameter
- Decontamination
- Environmental material types, volumes and drums used
- End-of-day status (i.e., partially complete, abandonment, etc.)
- Chronological record of activities

3.3 SAMPLING PROCEDURES

Two possible methods for collecting core and environmental samples are the continuous core method and the drive sample method. The continuous coring method advances a split barrel that is contained within the lead auger. The augers rotate around the sampler and cut while the sample barrel is prevented from rotating. Continuous core samples are collected in the barrel. The drive sample method collects the core sample through the center of a hollow-stem auger. The auger, assembled with a center bit, drills to the desired sample depth. The center bit is then removed and the drive sampler is inserted through the augers. The 18 or 24-inch split barrel sampler is then driven with a 140-pound hydraulic or manually operated hammer to collect the sample. Drive samples will be obtained in general accordance with ASTM Designation D 1586 and SOP GT.2, Drilling and Sampling Using Hollow-Stem Auger Techniques (EG&G, 1992b).

The drive sample method is the method that will be used unless conditions require that the continuous core method be used (such conditions may be poor core recovery, or that the drive sampler is unable to be advanced, or any other condition that may occur where the driller thinks that core sampling would obtain better results). Once the drive sampler or the core barrel has been removed from the borehole, it will be opened, scanned with an alpha probe and a beta, gamma detector, and the length will be measured.

Soil samples will be collected from ground surface to the first bedrock interval collected. Six-foot composite samples will be collected during the implementation of this program and analyzed for TAL metals, total uranium, plutonium, americium, gross alpha, and gross beta as specified in the Work Plan. In order to obtain these composite samples, the sample will be placed in a safe location, out of the direct sun, until three consecutive 2-foot, or four consecutive 18-inch samples have been obtained. Once the three consecutive samples have been obtained, the samples will then be classified, logged, peeled, composited into a six-foot composite, and placed in appropriate containers for laboratory analysis according to SOP FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples (EG&G, 1992k). Procedures for sample peeling, handling and compositing will be followed according to SOP GT.2, Drilling and Sampling Using Hollow-Stem Auger Techniques (EG&G, 1992b).

An alternative sample method to be followed will be composite sampling based on lithology as opposed to six-foot intervals. The rig geologist will be responsible for implementing this method provided there is a distinct visible lithologic difference between natural geologic materials, artificial fill, ash material and/or visible changes within the ash layer(s). If this distinction can be made during drilling operations, composite samples will be made up of natural geologic materials and artificial fill, and ash materials, separately, and possibly separate subsamples within the ash layer(s) if visible changes occur.

Groundwater sample collection will be attempted from the boreholes at a frequency of one per IHSS, one per covered trenches or pits associated with each IHSS, and one for the pit and disturbed area east of IHSS 133.2, (i.e. a maximum of ten samples), in the event that groundwater is encountered. These samples will be collected via the Hydropunch II sampler, BAT® sampler in accordance with SOP GT.22,D, In-Situ Sampling with the BAT system (EG&G, 1992l), or any other sampling device, such as a well point and bailer, that is capable of collecting Level III, IV, and V quality samples. The BAT® and Hydropunch samplers are capable of collecting samples suitable for Level III, IV, and V quality of analyses. Samples collected with these samplers will be analyzed at an off-site laboratory specified by EG&G. The groundwater samples will be analyzed for the same analytes as the soil samples provided enough water is available. If the amount of groundwater is limited, the groundwater samples will be analyzed for total uranium (requiring 100 ml), gross alpha and gross beta (requiring 550 ml), and total TAL metals (requiring 1 L). Depending upon the amount of groundwater available, the priority in which the samples will be analyzed is uranium first, gross alpha and gross beta next, and TAL metals last. In addition, pH, specific conductance, temperature, dissolved oxygen, and barometric pressure will be measured in the field at the time of sample collection. Samples will be handled according to SOP FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples (EG&G, 1992k).

Quality assurance/quality control (QA/QC) samples will also be collected to assure that the QA/QC procedures are followed according to the Quality Assurance Project Plan (QAPjP), the site-specific Quality Assurance Addendum (QAA), and the QC requirements presented in SOP FO.13.

Ten percent of the soil samples collected will be collected for geotechnical (i.e., grain size) analyses, as stipulated in the Work Plan. Samples that are collected for geotechnical testing will consist of approximately 3/4-filled pint-sized glass jars with airtight lids placed in compartmented shipping cartons designed to prevent breakage of the jars. Sample peeling is not required for geotechnical samples.

3.3.1 Sample Containers And Preservative

In accordance with SOP FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples (EG&G, 1992k), only sample containers certified as clean by the manufacturer will be used for sample collection. The containers and preservatives will be obtained from the contracted analytical laboratory, their designated supplier, or a suitable chemical supply company. Any preservative(s) required will be added to the container by the contracted analytical laboratory or field sampling team prior to or during sample collection.

Sample numbers and location codes have been issued for the implementation of the soil boring program. The block of code numbers that will be used for the soil boring locations is 50092 through 59992. The block of code numbers that will be used for the soil samples collected during this program will be BH50000AS through BH55000AS.

Subsequent to sampling, the exterior of the sample containers will be decontaminated according to SOP FO.3, General Equipment Decontamination (EG&G,1992c), and placed in coolers lined with a plastic bag dedicated for sample and sample container transportation. Blue ice (or an equivalent) will be placed in the coolers.

Official custody of samples will be maintained and documented from the time of collection until the time that valid analytical results have been obtained or the laboratory has been released to dispose of the sample. Chain-of-custody procedures will be in accordance with SOP FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples (EG&G, 1992k).

4.0 DATA REDUCTION AND REPORTING

Prior to reporting any data, data validation must be performed. Guidelines used to evaluate analytical data are referenced in subsection 3.4.2 of Section No. 3.0 of the QAPjP. The laboratory validation process is also illustrated in Figure 3-1 of Section No. 3.0 of the QAPjP. Field data validation will be performed as specified in subsection 3.4.2 of Section No. 3.0 of the QAPjP. The Data Quality Objectives (DQOs) for validating the OU5 measurement data are presented in the Phase I Work Plan for OU5 (U.S. DOE, 1992a).

Reduction of field and laboratory data shall comply with SOP FO.14, Field Data Management, and the data reduction functions summarized in subsections 3.4.1 of Section No. 3.0 of the QAPjP. Laboratory data reduction will comply with the data deliverable requirements specified in the General Radiochemistry and Routine Analytical Services Protocol (GRRASP). Field data reduction shall be used in the data validation process to verify that the laboratory field controls and DQOs for measurement of data have been met.

Depending on the data validation process, data are flagged as either "valid", "acceptable with qualifications", or "rejected". The results of the data validation shall be reported in the EM Department Data Assessment Summary reports. The usability of data (the criteria of which is also described in subsection 3.3.7 of Section No. 3.0 of the QAPjP) shall also be addressed by the RI Project Manager.

5.0 REFERENCES

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EG&G, 1992b, Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) GT.2, Revision 2, Drilling and Sampling Using Hollow-Stem Auger Techniques, March 1, 1992.

EG&G, 1992c, Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) FO.3, Revision 2, General Equipment Decontamination, March 1, 1992.

EG&G, 1992d, Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) FO.4, Revision 2, Heavy Equipment Decontamination, March 1, 1992.

EG&G, 1992e, Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) GT.10, Revision 2, Borehole Clearing, March 1, 1992.

EG&G, 1992f, Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) GT.3, Revision 2, Isolating Bedrock From the Alluvium With Grouted Surface Casing, March 1, 1992.

EG&G, 1992g, Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) GT.4, Revision 2, Rotary Drilling and Rock Coring, March 1, 1992.

EG&G, 1992h, Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) FO.8, Revision 2, Handling of Drilling Fluids and Cuttings, March 1, 1992.

EG&G, 1992i, Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) FO.9, Revision 2, Handling of Residual Samples, March 1, 1992.

EG&G, 1992j, Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) GT.5, Revision 2, Plugging and Abandonment of Boreholes, March 1, 1992.

EG&G, 1992k, Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) FO.13, Revision 2, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples, March 1, 1992.

EG&G, 1992l, Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) GT.22,D, Draft, In-Situ Sampling With BAT System.

Owen, J.B. and L.M. Steward. 1973. Environmental Inventory: A Historical Summation of Environmental Incidents Affecting Soils at or Near the USAEC, Rocky Flats Plant. Dow Chemical Company, Rocky Flats Division, draft report.

Rockwell International. 1988. Draft Remedial Investigation and Feasibility Study Plans for Low Priority Sites. Rocky Flats Plant, Golden, Jefferson County, Colorado. Vol. 1, June 1988.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: ____________ Surface Elevation: ____________
Location - North: ________ East: ________ Area: ____________
Date: ____________ Total Depth: ____________
Geologist: ____________ Company: ____________ Project No.: ________
Drilling Equip.: ____________ Sample Type: ____________

EG&G LOGGING SUPERVISOR
APPROVAL ____________ DATE ____________

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL IN BOX	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL\ LITHOLOGIC LOG	SAMPLE DESCRIPTION

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurage footage measurements not possible.

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden Colorado

OPERABLE UNIT NO. 5
TECHNICAL MEMORANDUM 7

FIGURE 9-A

BOREHOLE LOG FORM (FRONT)

PRELIMINARY WELL-SITE FIELD LOG

Date: ______________________

Rig Geologist: ______________________ Company: ______________

NOTES:

U.S. DEPARTMENT OF ENERGY *Rocky Flats Plant* *Golden Colorado*
OPERABLE UNIT NO. 5 *TECHNICAL MEMORANDUM 7*
FIGURE 9-B
BOREHOLE LOG FORM (BACK)

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM GT.2A

HOLLOW-STEM AUGER DRILLING FIELD ACTIVITIES REPORT

PROJECT NUMBER ______________________

DATE ______________________

PROJECT NAME ______________________

BOREHOLE IDENTIFICATION ______________________

WEATHER CONDITIONS ______________________

RIG TYPE ______________________

DRILLING COMPANY/DRILLER ______________________

GEOLOGIST/ENGINEER ______________________

CREW MEMBERS ______________________

WATER LEVEL/TIME ______________________

TOTAL DEPTH ______________________

DECONTAMINATION ______________________

ENVIRONMENTAL MATERIALS TYPES, VOLUMES, AND DRUMS USED ______________________

____

____

DIAMETER OF BORING ______________________

TYPE AND SIZE OF AUGERS AND BIT ______________________

SAMPLING TYPES, DEPTHS ______________________

____

____

HAMMER SIZE ______________________

DEPTH TO BEDROCK ______________________

END-OF-DAY STATUS ______________________

CHRONOLOGICAL RECORD OF ACTIVITIES ______________________

____

____

COMMENTS ______________________

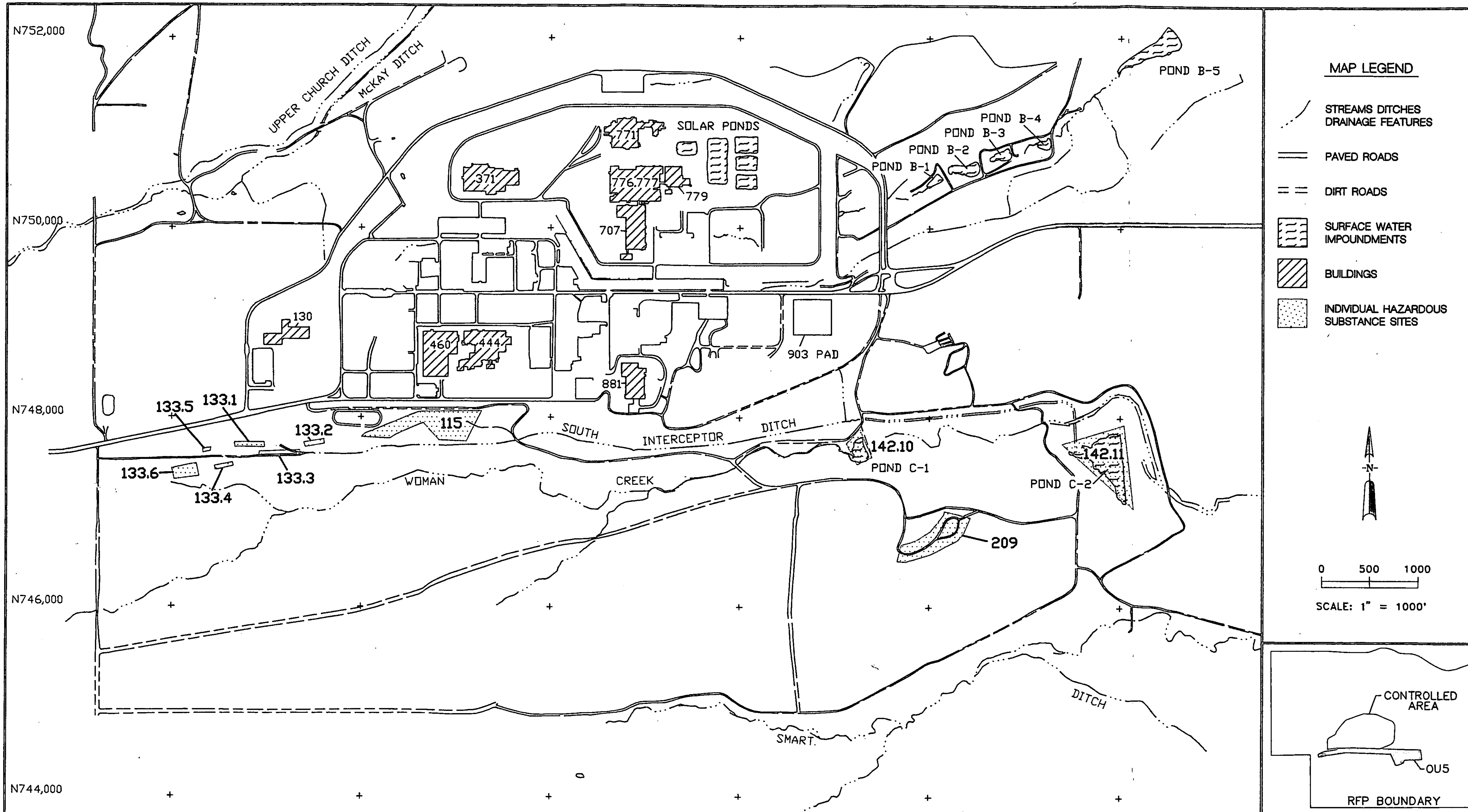
____

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden Colorado

OPERABLE UNIT NO. 5
TECHNICAL MEMORANDUM 7

FIGURE 10

AUGER DRILLING FIELD ACTIVITIES REPORT FORM



SITE LOCATION MAP

TM7 - SOIL BORING SAMPLING PLAN

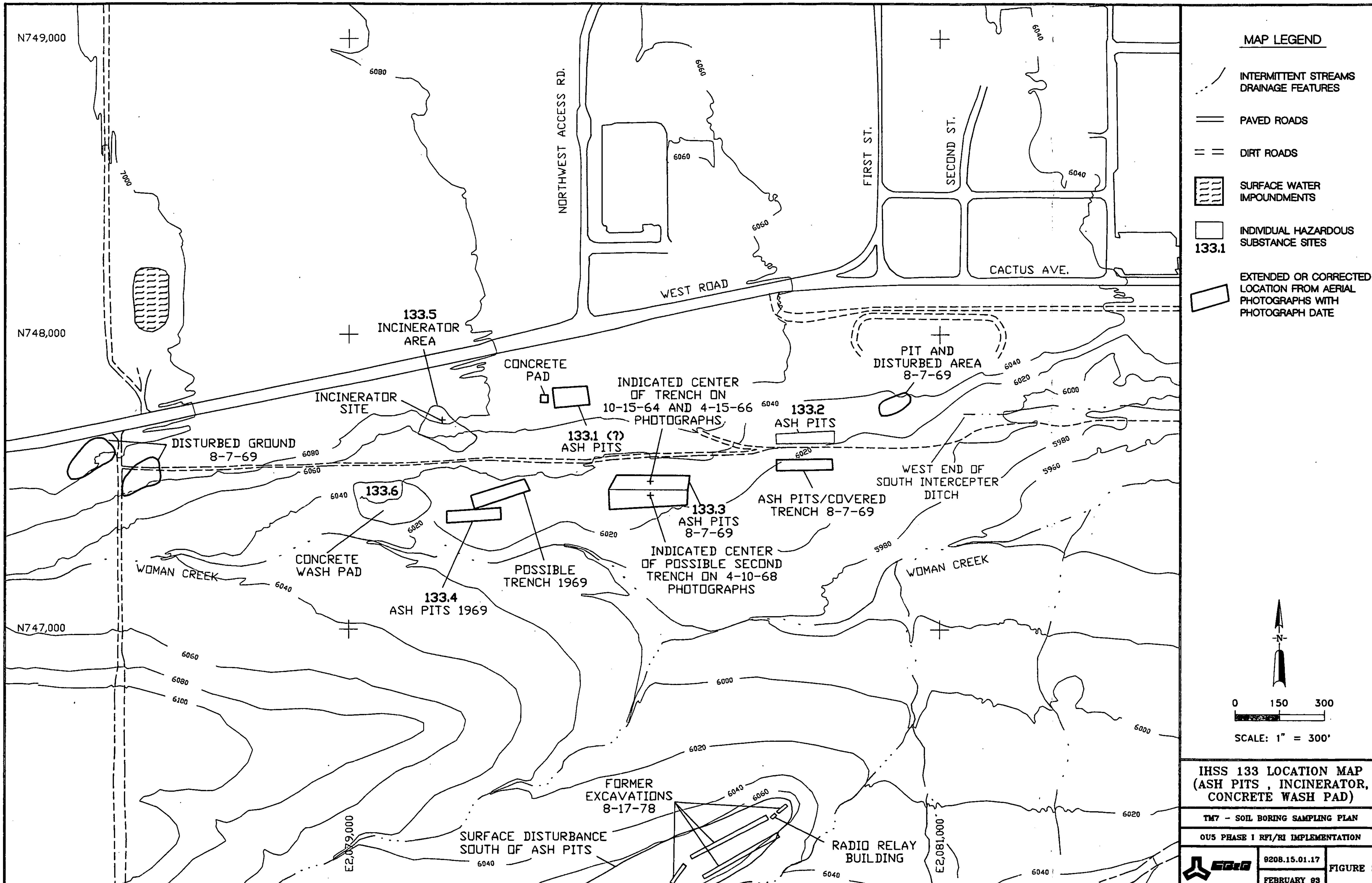
OU5 PHASE I RFI/RI IMPLEMENTATION

9208.15.01.17

FEBRUARY 93

FIGURE 1

05TM7-LDWG

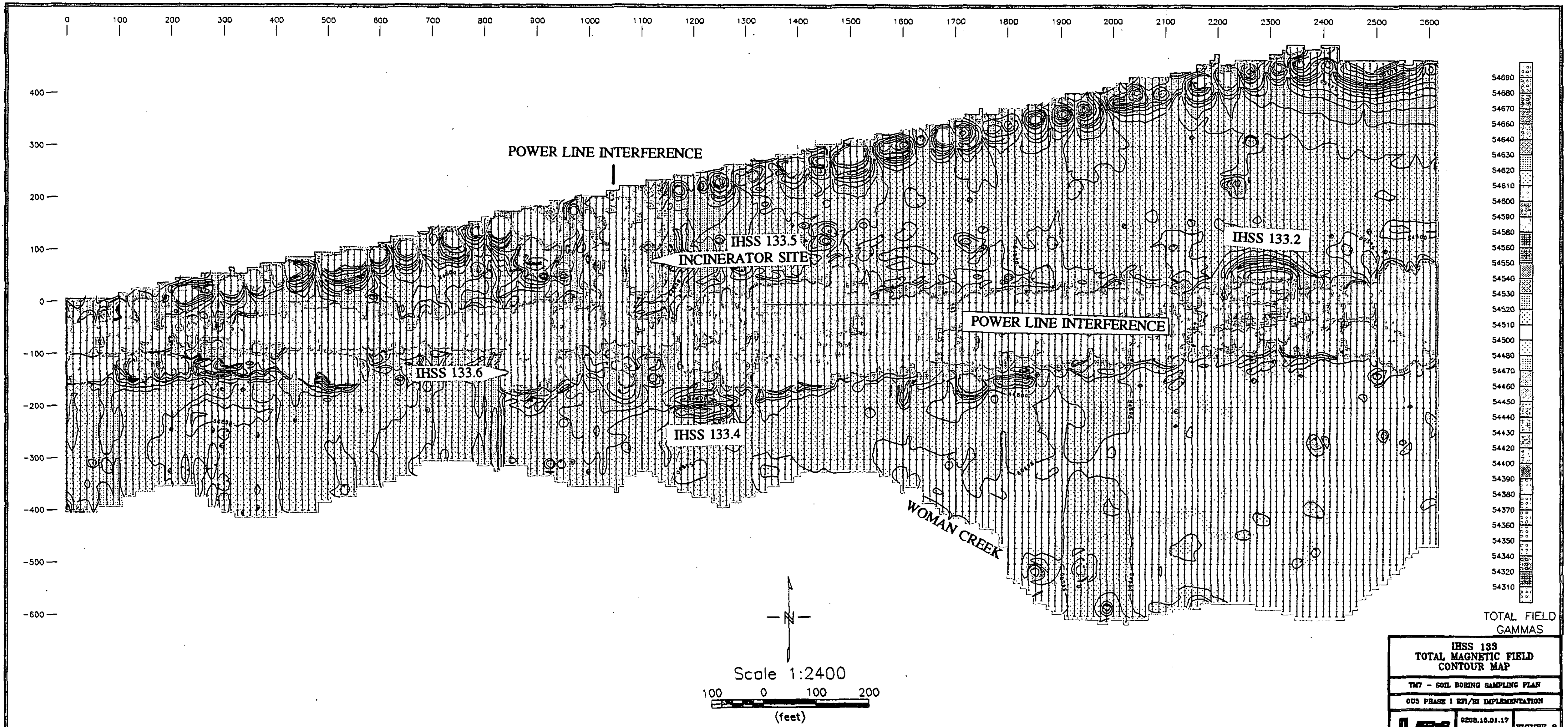


IHSS 133 LOCATION MAP
(ASH PITS , INCINERATOR,
CONCRETE WASH PAD)

TM7 - SOIL BORING SAMPLING PLAN

OU5 PHASE I RFI/RI IMPLEMENTATION

FIGURE 2



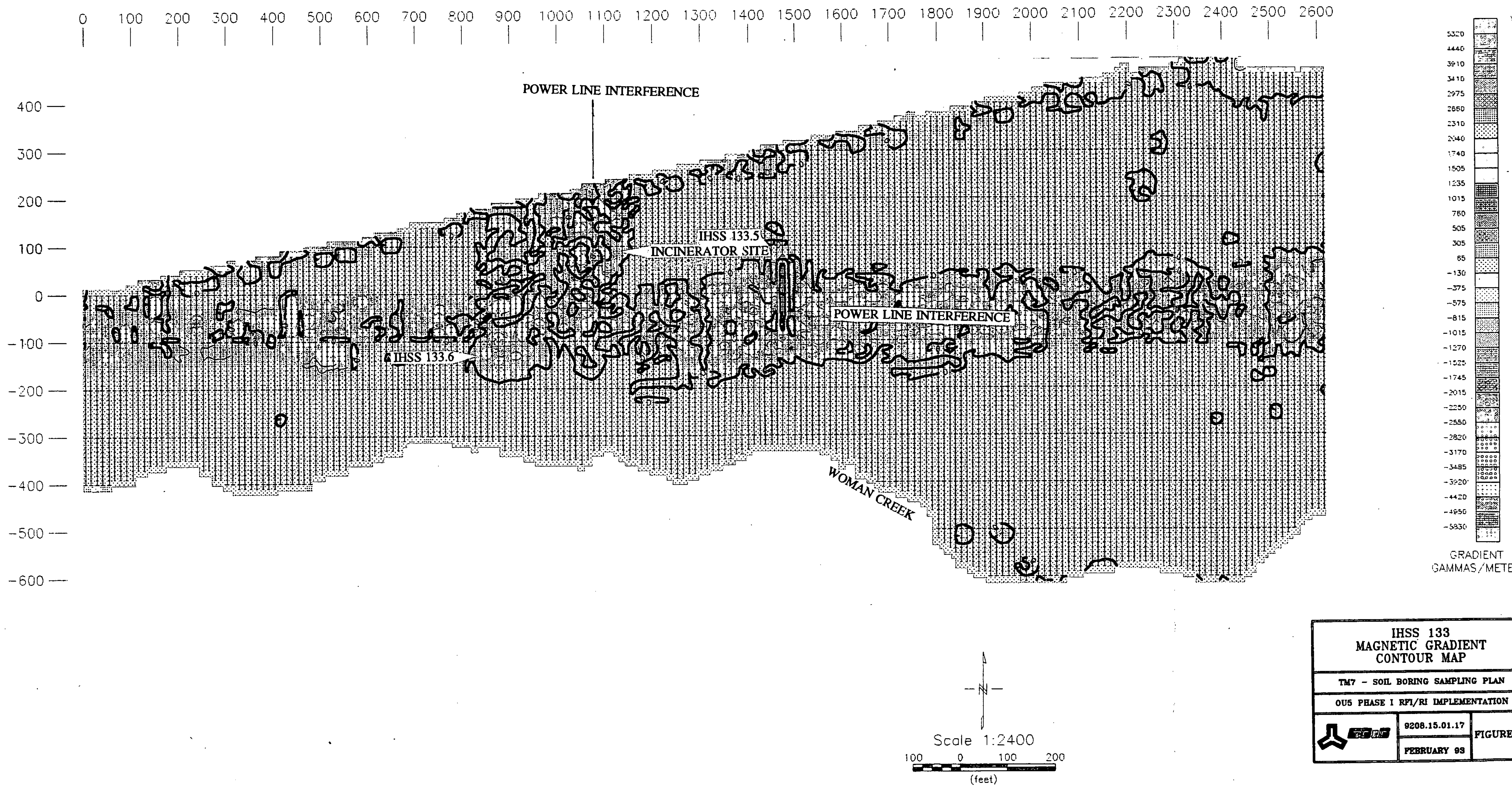
IHSS 133
TOTAL MAGNETIC FIELD
CONTOUR MAP

TM7 - SOIL BORING SAMPLING PLAN

OU5 PHASE I RFI/RI IMPLEMENTATION

9208.15.01.17 | FIGURE 3

FEBRUARY 93

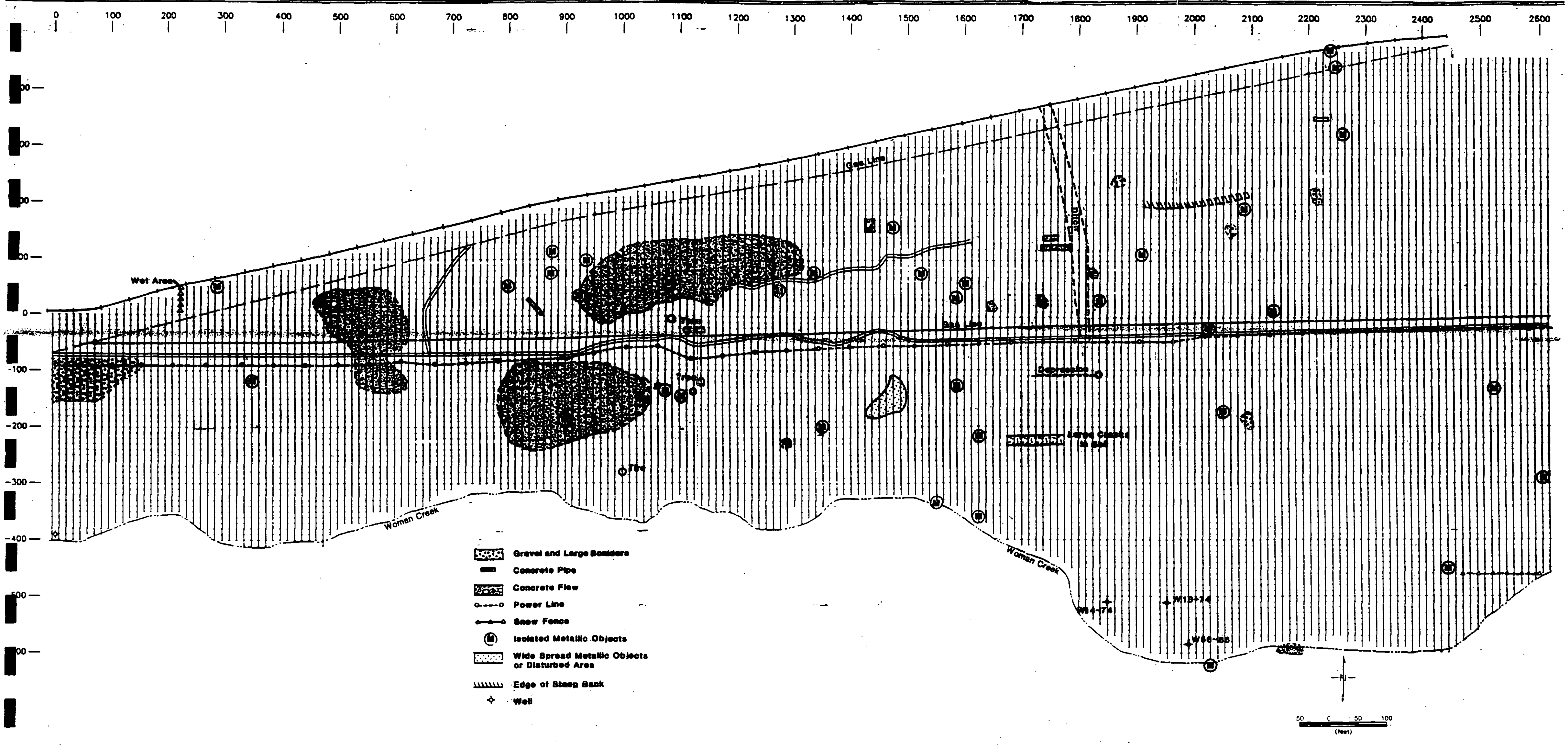


IHSS 133
MAGNETIC GRADIENT
CONTOUR MAP

TM7 - SOIL BORING SAMPLING PLAN

OU5 PHASE I RFI/RI IMPLEMENTATION

	9208.15.01.17	FIGURE 4
	FEBRUARY 93	



IHSS 133
SURFACE FEATURES
LOCATION MAP

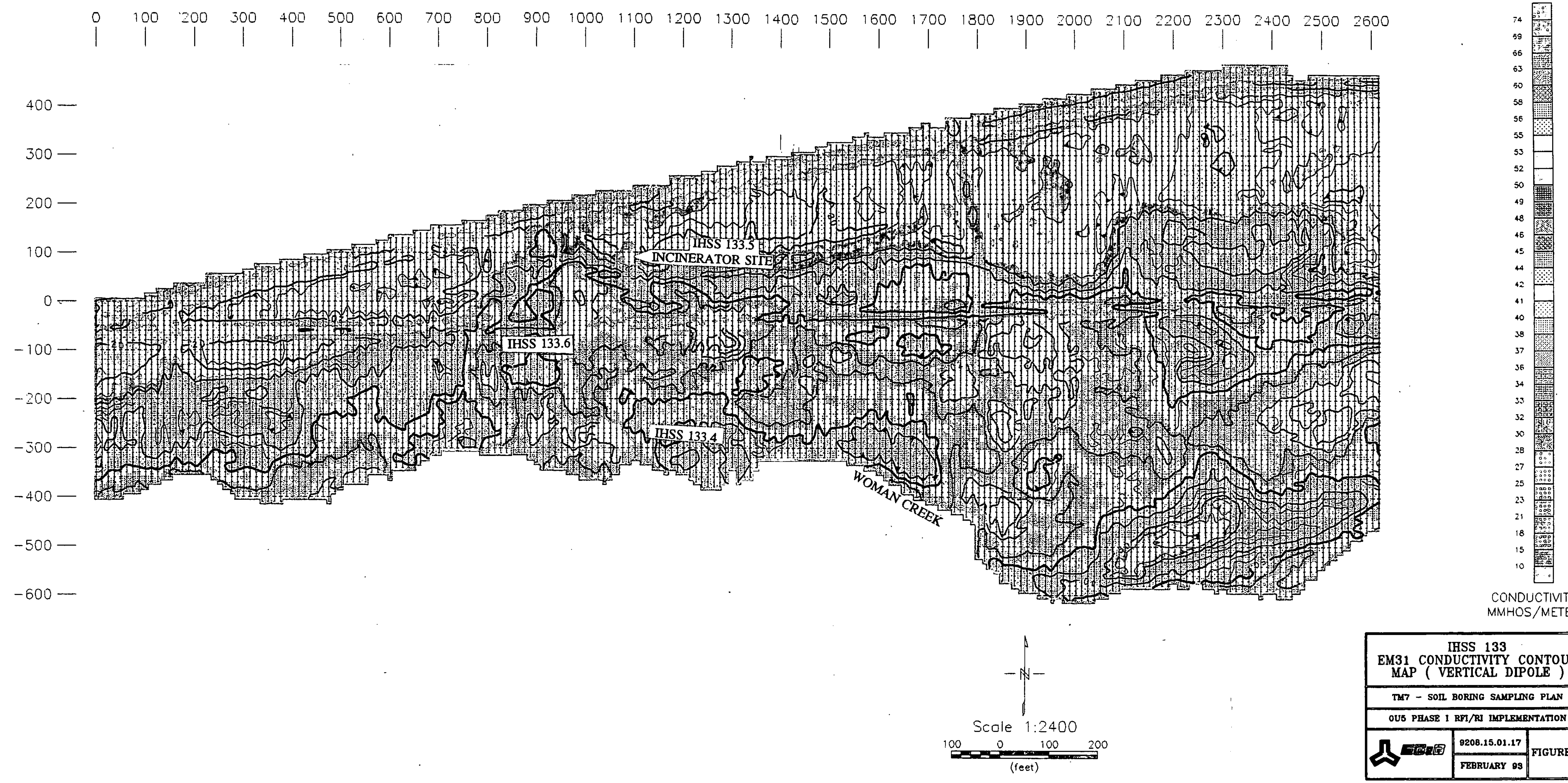
TM7 - SOIL BORING SAMPLING PLAN

OU5 PHASE I RFI/RI IMPLEMENTATION

9208.15.01.17

FEBRUARY 93

FIGURE 5



IHSS 133
EM31 CONDUCTIVITY CONTOUR MAP (VERTICAL DIPOLE)

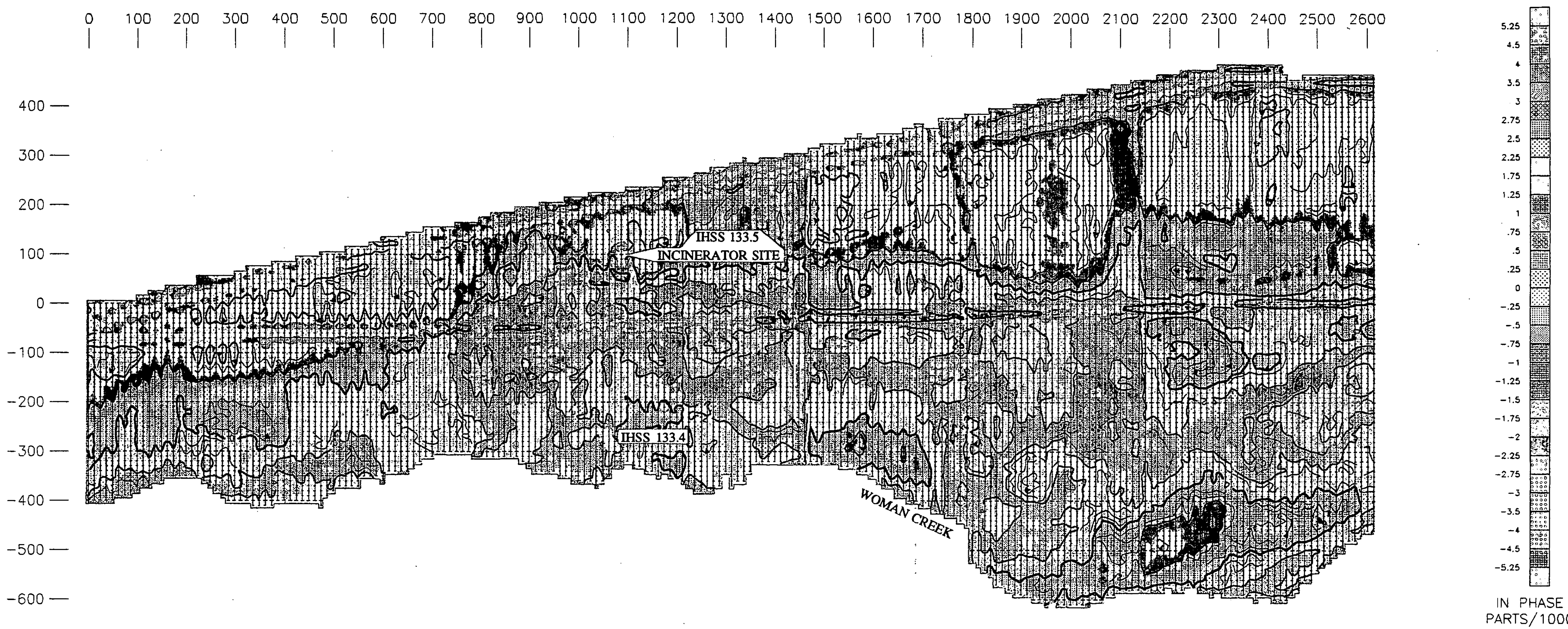
TM7 - SOIL BORING SAMPLING PLAN

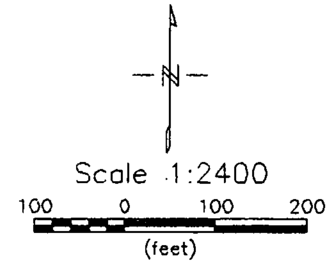
OU5 PHASE I RFI/RI IMPLEMENTATION

9208.15.01.17

FEBRUARY 93

FIGURE 6



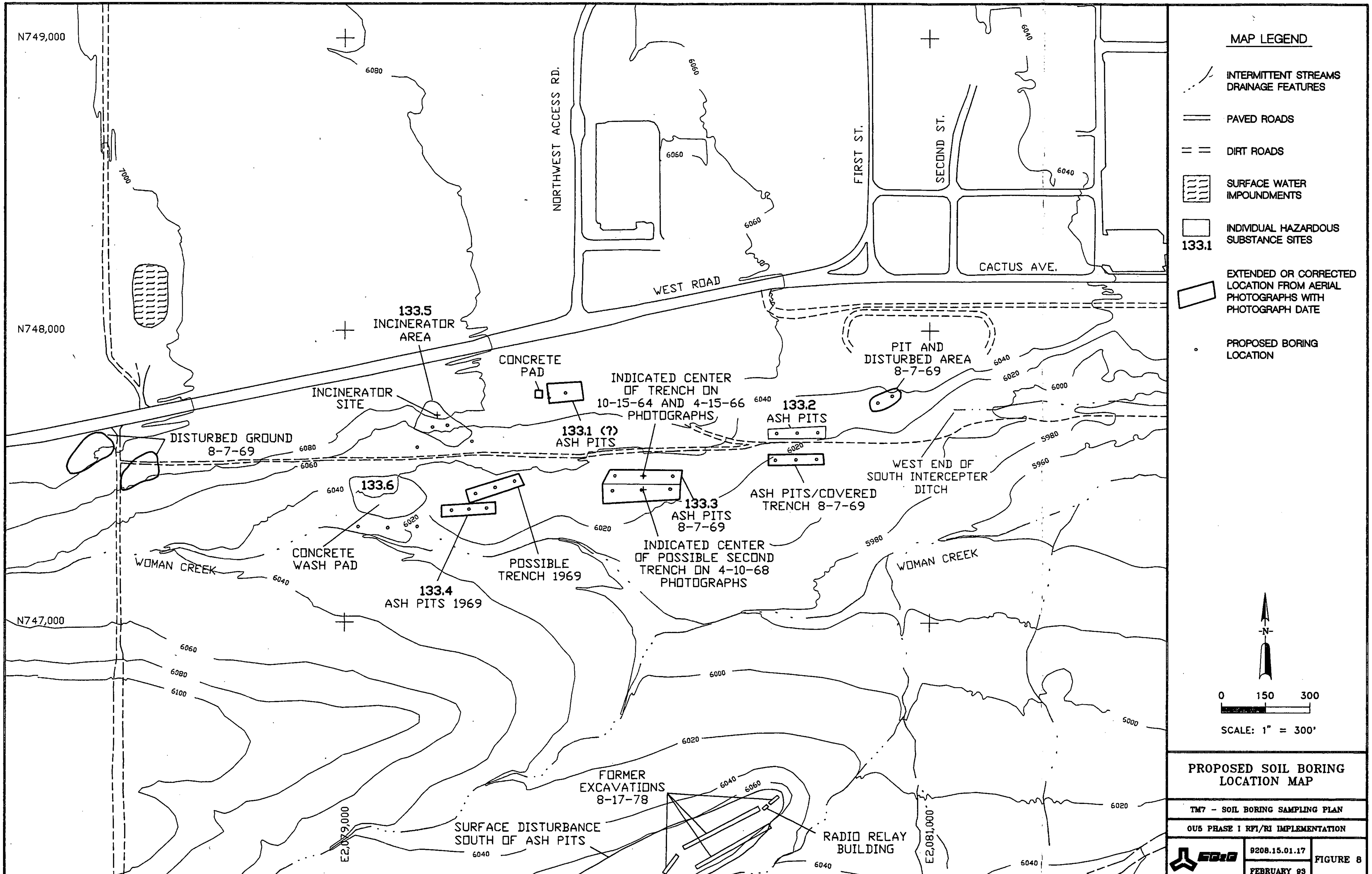


IHSS 133
EM31 IN PHASE CONTOUR MAP (VERTICAL DIPOLE)

TM7 - SOIL BORING SAMPLING PLAN

OU5 PHASE I RFI/RI IMPLEMENTATION

EG&G	9208.15.01.17	FIGURE 7
	FEBRUARY 93	


N749,000
N748,000
N747,000
E2,079,000
E2,081,000
NORTHWEST ACCESS RD.
FIRST ST.
SECOND ST.
WEST ROAD
CACTUS AVE.
6080
6060
6040
6020
6000
5980
5960
7000
6100
133.5
INCINERATOR
AREA
INCINERATOR
SITE
CONCRETE
PAD
133.1 (?)
ASH PITS
INDICATED CENTER
OF TRENCH ON
10-15-64 AND 4-15-66
PHOTOGRAPHS
133.2
ASH PITS
PIT AND
DISTURBED AREA
8-7-69
DISTURBED GROUND
8-7-69
133.6
CONCRETE
WASH PAD
133.4
ASH PITS 1969
POSSIBLE
TRENCH 1969
133.3
ASH PITS
8-7-69
INDICATED CENTER
OF POSSIBLE SECOND
TRENCH ON 4-10-68
PHOTOGRAPHS
ASH PITS/COVERED
TRENCH 8-7-69
WEST END OF
SOUTH INTERCEPTER
DITCH
WOMAN CREEK
WOMAN CREEK
FORMER
EXCAVATIONS
8-17-78
SURFACE DISTURBANCE
SOUTH OF ASH PITS
RADIO RELAY
BUILDING
MAP LEGEND
INTERMITTENT STREAMS
DRAINAGE FEATURES
PAVED ROADS
DIRT ROADS
SURFACE WATER
IMPOUNDMENTS
133.1
INDIVIDUAL HAZARDOUS
SUBSTANCE SITES
EXTENDED OR CORRECTED
LOCATION FROM AERIAL
PHOTOGRAPHS WITH
PHOTOGRAPH DATE
PROPOSED BORING
LOCATION
N
0
150
300
SCALE: 1" = 300'
PROPOSED SOIL BORING
LOCATION MAP
TM7 - SOIL BORING SAMPLING PLAN
OU5 PHASE I RFI/RI IMPLEMENTATION
9208.15.01.17
FEBRUARY 93
FIGURE 8
05TM7-2.DWG